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Framing Contests and Cumulation in Institutional Emergence: The Case of the Diesel Particulate Filter in Germany

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FRAMING CONTESTS AND CUMULATION IN INSTITUTIONAL EMERGENCE: THE CASE OF THE DIESEL PARTICULATE FILTER IN GERMANY[1]

ABSTRACT

Based on an in-depth case study, this paper examines how framing contests between proponents and opponents of the Diesel particulate filter (DPF) in Germany evolve over time to affect institution creation. Our results suggest that the emergence of institution passes through three cumulative phases: necessary opening, organizing-mobilizing, instrumentalization of channels. This development is characterized by specific framing contests where the precedent phase is a necessary condition for the next to occur, a process which we conceptualize as cumulation. Our data indicate that framing contests were resolved when collective action frames which have a motivational task were crafted by the social movement with the effect of mobilizing customers, thereby creating a *de facto* standard i.e. the Diesel particulate filter. We argue that the motivational frame resonated because it features negative individualized evidence-based consequences and because it built on the framing contests of previous phases. Finally, we observed that framing contests tend to polarize over time, thereby reflecting the intensity of the conflict.

KEYWORDS

Framing contest, institution emergence, social movement, collective action frame, polarization, phases, cumulation mechanism.

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INTRODUCTION

The emergence of novel institutions is one of the major forces which enables societal change and is an important theme in organizational theory (Davis, McAdam, Scott, & Zald, 2005). Institutions do not only emerge because they constitute appropriate answers to local problems (Tolbert & Zucker, 1996), they may also arise from intensive collective struggles where actors combine their efforts to raise armies of activists ready to challenge existing institutions and propose new ones. There is a growing body of literature which acknowledges that social movements can play an important role in institution creation (Schneiberg & Lounsbury, 2008). For example, social movement activities were found to be a powerful motor to shift institutional logic in professional settings (Greenwood, Suddaby, & Hinings, 2002; Rao, Monin, & Durand, 2003), to create new organizational forms (Rao, 1998; Rao, Morrill, & Zald, 2000) and to create new markets (King & Pearce, 2010; Sine & Lee, 2009; Weber, Heinze, & DeSoucey, 2008).

Fundamentally, social movements need to mobilize actors and resources in order to change a given situation. At the same time, those who resist the proposed change need to organize to protect the *status quo*. One of the main and most powerful tool activists can use to attack opponents are collective action frames, i.e. rationales to mobilize activists (Benford & Snow, 2000). Resisters on the other hand, engage and mobilize defensive arguments. Through collective action frames, activists, resisters and other parties may engage in struggles over meaning, i.e. what the social movement literature calls framing contests (Benford & Snow, 2000). Yet most of the studies in this literature focus on the framing activities of the movement (Davis et al., 2005; McAdam, McCarthy, & Zald, 1996) without explicitly looking at the resistance and the counter-framing activities of the parties under attack (e.g. Rao et al., 2003; Schneiberg & Soule, 2005; Sine & Lee, 2009; Weber et al., 2008 and see also the comment of Hargrave and Van de Ven, 2006) or, when they have done so, their analysis has

been more static than processual (e.g., Creed, Scully, & Austin, 2002; Suddaby & Greenwood, 2005). Consequently, little empirical research has explicitly looked at the framing activities deployed by both the proponents and opponents of new norms or standards and how framing contests evolve and unfold over time to enable the emergence of novel institutions. Furthermore, this gap does not seem idiosyncratic to the social movement literature as similar criticisms have been formulated about the institutional entrepreneurship literature. As Hardy and Maguire (2008) and Lounsbury and Crumley (2007) remark, most studies of the institutional entrepreneurship literature have tended to use actor-centric analysis where the voices of institutional entrepreneurs have been prominently heard and where the resistance of those under fire has been mainly overlooked.

In order to explore how framing contests evolve over time to enable institutional change, we conducted an in-depth longitudinal case study analysis. We chose the case of the Diesel particulate filter (DPF) in Germany because it features extremely dichotomized parties having incompatible institutional goals, namely the car industry and the environmental movement in Germany. The case is characterized by the mobilization of 97 social movement organizations which were requesting the German car manufacturers to equip Diesel cars with DPF in order to reduce pollution. This gave rise to intense framing contests where manufacturers largely resisted the proposition of the environmental movement to make the DPF a *de facto* standard (Abrahamson & Rosenkopf, 1997; Kim & Pennings, 2009) i.e. a standard which is not imposed through regulation but emerges bottom-up, for Diesel cars in Germany. Our analysis focuses on how struggles between collective action frames, elaborated by the proponents and opponents to the DPF becoming a *de facto* standard, evolved over time and how a new institution such as a *de facto* standard emerges.

By comparing collective action frames of both parties involved in framing contests, this study contributes to the literature in three ways. Firstly, our results suggest that the emergence of

institution passes through three cumulative phases where the precedent phase is a necessary condition for the next to happen. The first phase, *necessary openings*, concerns the elaboration of collective action frames accomplishing diagnostic (identifying a problem) and prognostic tasks (identifying a solution). The second phase, *organizing-mobilizing*, corresponds to the formation of environmental coalitions which provide legitimacy for further framing contests. The third phase, *instrumentalization of channels*, is characterized by the crafting of frames having a motivational task (rationale to engage in a movement) with the effect of mobilizing consumers and creating a *de facto* standard i.e. the Diesel particulate filter. Secondly, we argue that the motivational frame resonates with consumers because it features negative individualized consequences and because it occurred after the necessary conditions for a war over the emergence of a new institution were established. Thirdly, our results suggest that frames develop over time and become increasingly evocative and extreme, a phenomenon which we call frame polarization, as framing contests within the first phases do not lead to intended institutional emergence.

The remainder of the paper is structured as follows. We first describe the theoretical background of our study. We then explain the research context, the scope and the methodology of this research. This is followed by a chronological presentation of the case study, drawing particular attention to the framing contests which unfolded on both sides of the interaction. The next section analyses the framing activities of the proponents and the opponents to the DPF. We terminate this paper with a discussion on the theoretical implications of our findings.

FRAMING CONTESTS AND THE EMERGENCE OF INSTITUTION

Originally borrowed from Goffman (1974), a frame is a schema of interpretation which helps in understanding events and objects surrounding us. Snow and Benford (1988) adapted this term to make it fit the social movement literature and created the term *collective action frame*

which, like Goffman's concept, still performs an interpretative function, but is "intended to mobilize potential adherents and constituents, to garner bystander support, and to demobilize antagonists" (Snow & Benford, 1988: 198). From this perspective, framing is a strategic process which may lead to frames i.e. the "outcome[s] of negotiated meaning" (Gamson, 1992). It is the "conscious strategic efforts by group of people to fashion shared understandings of the world and of themselves that legitimate and motivate collective action" (Snow, Rochford, Worden, & Benford, 1986). This is the definition which we adopt for this study.

While the concept of framing has been mainly used in the social movement literature to explain strategies for acquiring resources, recruiting new members or mobilizing adherents (Benford & Snow, 2000; McAdam et al., 1996; McCarthy & Zald, 1977), there is recent interest in understanding how social movement affects institutional change (Hardy & Maguire, 2008; Schneiberg & Lounsbury, 2008). These works are largely based on the assumption that societies are so complex and heterogeneous (Boltanski & Thévenot, 2006; Friedland & Alford, 1991) that there is wide scope for conflict to arise and for actors to engage in wars over signification. While most of the literature on social movement documents the action of movement against the State (King & Pearce, 2010), several other actors such as professionals, key suppliers, consumers and other organizations may also engage in framing activities and shape institution creation (DiMaggio & Powell, 1983). However, if the framing activities of several actors having divergent interests collide, framing contests may ensue. Building on previous work (e.g. Kaplan, 2008), we define *framing contest* as the struggle over meaning which attempts to influence the interpretative schemes of actors involved in a given situation.

Much of the literature on social movement which mobilizes the concept of framing contest has attempted to document the creation of different types of institutions ranging from promoting new organizational forms (Schneiberg & Soule, 2005), endorsing new markets

(Sine & Lee, 2009; Weber et al., 2008), shaping identity (Greenwood et al., 2002; Markowitz, 2007; Rao et al., 2003), forging new institutional logics (Nigam & Ocasio, 2010), legitimating products (Rao, 2002) and new practices (Maguire, Hardy, & Lawrence, 2004), and even the emergence of technological standards (Garud, Jain, & Kumaraswamy, 2002). All these studies assume that framing contests are a central mechanism leading to institution creation but none of them explicitly documents how struggles over meaning evolve over time by simultaneously looking at both sides of the interaction, i.e. little attention is paid to the response of the opponents. For example, Weber (2008) shows how the social movement contested the current meat and dairy product system by proposing to produce grass-fed meat and dairy products. Their work examines in great detail the frames developed by activists which led to the creation of the grass-fed beef market. While this study is exemplary in many respects, it does not examine opponents' reactions to the attack of the social movement. Another example is the in-depth examination of public attention to Clinton's health care reform initiative by Nigam and Ocasio (2010) which proposes that "as event attention leads to new forms of representation of the environment, new forms of theorization emerge, and as these new forms of theorization and representation become aligned with newly emergent field-level practices, they develop into a dominant institutional logic" (p.824). While these authors develop a model of how new institutional logics become dominant, their analysis focuses mainly on the framing activities of the proponents of the new institution.

While these studies look at only one side of the interaction, others explicitly compare the framing and counter-framing activities of protagonists engaged in struggles over meaning, but their analysis is static, either leaving the dynamic of framing contests over time aside or presenting two competing frames which do not interrelate. These studies investigated how social movement, social entrepreneurs and framing contests promote new organizational forms (Rao, 1998; Suddaby & Greenwood, 2005) or shape identity (Creed et al., 2002). For example, Rao (1998) looks at how competing entrepreneurs mobilized incompatible collective

action frames in an attempt to legitimize the organizational form which they promoted. However, the analysis of these frames occurs in parallel. Another example is the exhaustive study of Creed et al. (2002) which shows how the master frames available in the environment are mobilized in framing to create legitimating accounts. Perhaps the only exception to this situation is the work of Kaplan (2008) who documented how framing contests unfolded over time, but she did it inside an organization and not at the field level.

Overall, these studies do not explicitly document at the same time how framing activities are elaborated by the opponents and the proponents and how framing contests evolve over time. Rather, they examine the development over time of the unilateral relationship of those who are framing a situation or they document framing contests in a static way leaving the time dimension aside. We believe that combining both the time dimension and collective action frames of the proponents and opponents involved in framing contests is essential in order to identify the mechanisms which affect the outcome or the resolution of framing contests which may manifest itself in the form of institution creation. Furthermore, a comparative analysis between the proponents and opponents to a technological standard should lead to new theoretical insights (Eisenhardt, 1989; Langley, 2009).

A characteristic of the concept of framing as defined by the social movement literature is that it takes into account the content of collective action frames deployed by activists (Hardy & Maguire, 2008). Such content suggests that framing can be decomposed into three core tasks (Benford & Snow, 2000). The *diagnostic framing task* is the process by which problems are identified and blame is attributed to specific actors. The *prognostic framing task* involves arguments related to the identification of a solution to the problem. Finally, the *motivational framing task* provides a rationale for engaging in a movement (Benford and Snow, 2000). These basic tasks have to be complemented by other factors in order for frames to resonate i.e. to be effective. The proffered frames must be credible (consistent, empirically supported and

the claim-makers must be credible) and they have to be relatively salient (central and coherent in terms of beliefs, values, ideas, myths, and everyday life of the targets of mobilization) (Benford et al, 2000). Regarding salience, scholars have come to realize that actors must draw from a repertoire of frames (Clemens, 1993; Kaplan, 2008) or master frames (Benford & Snow, 2000; Creed et al., 2002) to elaborate legitimate accounts, otherwise their frame might not resonate.

Besides these characteristics leading to frame resonance, the literature documents four framing strategies which can be used to increase the mobilization of participants in a movement (Kaplan, 2008; Snow et al., 1986). These strategies are: frame bridging (linking two ideologically similar but structurally separate frames), frame amplification (highlighting selected beliefs or values), frame extension (through direct contact activists shape their message to connect with values of the person to mobilize), and frame transformation (new values are promoted, for example something taken-for-granted can be framed as problematic). Finally, actors who are the developers and carriers of collective action frames have to be perceived as credible (Kaplan, 2008).

While the concept of framing is central in the social movement literature (McAdam et al., 1996), the notion of theorization [2] used in the institutional theory is closely related. Theorization rapidly evolved to be conceptualized as a discursive strategy to provide legitimacy to an innovation (Tolbert & Zucker, 1996) and came to include properties such as diagnostic and prognostic tasks (Greenwood et al., 2002), making this concept really close to framing. In the same manner that frames can become master frames (Benford & Snow, 2000),

[2] Theorization was initially defined as "the self-conscious development and specification of abstract categories and the formulation of patterned relationships such as chains of cause and effect" in Strang, D., & Meyer, J. W. 1993. Institutional conditions for Diffusion. ***Theory and Society***, 22: 487-511.

theorizations can become institutional logics (Nigam & Ocasio, 2010; Thornton & Ocasio, 2008). According to Soule (2004), the only distinction between the concepts of framing and theorization is that theorization specifies in addition who should adopt an innovation. We draw on both ideas in the paper.

RESEARCH CONTEXT AND METHODOLOGY

Research context and scope of the research

Due to the context-sensitive nature of our inquiry (Patton, 2002; Yin, 2003) and our focus on processual data (Yin, 2003), we used a case study approach with embedded units of analysis. Specifically, this case documents the activism of environmentalists urging the German automotive industry to reduce the emission of particulate matters by introducing the DPF technology. The final outcome which we attempt to explain is not regulative, but normative, as we investigate how the emerging demand forced the car manufacturers to react swiftly to include the DPF technology as a default equipment of Diesel cars in Germany only. Thus, this case takes place within Germany from the mid-eighties to mid-2005, when the car manufactures largely gave in and announced to equip all their Diesel cars standardly with DPFs.

We selected this case for two reasons. First, experts of both the German environmental movement and the automotive industry identified this case as having the potential to reflect intensive framing contest activity. As Germany is recognized for having both a powerful automotive industry and particularly active environmental NGOs, we expected to observe several instances of intense struggle for meaning. The automotive industry constitutes one of the most important industrial sectors in Germany, accounting for 866,000 employees and 17 percent of the entire export volume (Heneric, Licht, & Sofka, 2005). Overall, almost six million cars are assembled each year in Germany. The main actors are German original-equipment manufacturers (OEMs) such as Volkswagen (VW, including Audi), Daimler

(Mercedes and Smart) and BMW, but also foreign car manufacturers with a strong domestic manufacturing presence such as Ford and General Motors (Opel). The environmental movement is also extremely powerful and institutionalized in Germany, having 900 organizations and about 3.5 million members (Brand, 1999; Carter, 2007). Main actors of the social movement organizations in Germany are BUND (German Association for Environment and Nature Protection), DUH (German Environmental Help), NABU (The Society for Nature Conservation), VCD (Traffic Club Germany) and Greenpeace.

Second, although it is embedded in a wider context of emission regulations (the next section provides some details), the case is well confined to Germany. All our interview partners stressed that the heated public debate on Diesel particulate matter and the DPF was an endemic German phenomenon. For example, Louis Schweitzer, the former chairman of Renault, said that "The discussion about the soot filter for diesel cars is typical German and not at all a topic in France" (*Die Welt*, April 10, 2005). In fact, as our case analysis will show, the debate in Germany was only indirectly linked to the emission regulations. On the contrary, due to the pressure from customers, German car manufacturers decided to install DPF systems (as standard equipment) significantly before the Euro 5 emission norm made it a necessity in 2009.

Technical background

During the last 20 years, Diesel-powered cars have become very popular in Germany. However, compared to spark-ignition engines (running on petrol), Diesel engines emit a relatively high amount of particulate matter (PM). Diesel exhaust particulate matter is a complex mixture of different substances but its main component is carbonaceous soot. To characterize the wide distribution of the particle sizes, it is common to distinguish fine ($PM_{2.5}$ with a diameter < 2.5 μm and PM_{10} with a diameter < 10 μm) and ultrafine (< 100 nm) particles. Diesel exhaust particulate matter is a significant anthropogenic source of the overall

particulate matter concentration in the atmosphere (outdoor air), particularly in areas of heavy traffic such as inner cities.

As there is accumulated empirical evidence (for a review, see Pope & Dockery, 2006) that suggests a link between the concentration of particulate matter in the atmosphere and adverse health effects, particulate matter emissions are regulated in many countries. Within the EU, the corresponding regulatory environment is formed by two bodies of regulation: (1) *Exhaust emission standards* which set upper limits to the amount of pollutants (such as particulate matter) that are allowed to be discharged from a vehicle's tailpipe into the environment and (2) *air pollution standards* which set upper limits to the concentration of pollutants in the atmosphere. Since the introduction of the first exhaust emission standards, several amendments have progressively tightened the limits for Diesel particulate matter emissions. The standards are commonly referred to as Euro 1 (introduced in 1992, Diesel PM < 140 mg/km), Euro 2 (in 1996, < 100 mg/km), Euro 3 (in 2000, < 50 mg/km, Euro 4 (in 2005, < 25 mg/km) and Euro 5 (in 2009, < 5 mg/km).

In order for their Diesel engines to comply with the increasingly stringent regulations, car manufacturers can basically use two approaches: (1) *"internal engine" methods* and (2) *exhaust after-treatment* methods (Eastwood, 2008). With regard to the former, there are several techniques that optimize the combustion so that the engine produces less particulate matter. Among other things, a popular direction is to burn the Diesel fuel in a well-controlled mix of excess air ("lean burn") (Dunn-Rankin, Miyasato, & Pham, 2008). With regard to the latter, the exhaust gas can be cleansed of particulate matter by using DPF systems which are installed between the engine and the tailpipe. While a DPF can reduce particulate matter very effectively, it involves a number of technological challenges (thermal robustness, regeneration mechanisms and counter-pressure) and trade-offs (DPFs may increase fuel consumption and CO_2 emissions). For example, Mercedes-Benz introduced the first Diesel car with DPF in

1985 in the US, but after three years ceased commercialization due to significant technical problems. These challenges, however, have been tackled later and in 2008, Eastwood noted that "forthcoming statutory limits are unlikely to be met by any other means [than the DPF]" (Eastwood, 2008: 294).

Data collection

In order to document how framing contests evolve over time and affect institution creation, we collected data from several sources. First, twelve in-depth interviews of 60 to 120 minutes were conducted with different specialists and activists in order to gain a good representation of the main arguments and events which occurred in the case. Three interviews were conducted with key managers and engineers of car manufacturers in Germany, five with environmental activists, two with members of the German government, one with a car expert and one with an expert on environmental issues. These interviews provided the basis for the case study. We started each interview with an open-ended question inviting the interviewee to tell the story of the DPF in Germany spontaneously with emphasis on the arguments which were elaborated by the different constituents involved in the case study.

While these interviews allowed us to construct the backbone of the case study, we needed to complement this data with written documents to avoid memory bias (Eisenhardt, 1989), to identify with greater precision the dates of important events (Langley, 2009) and to triangulate our data in order to obtain an accurate case narrative (Yin, 2003). Our launching point was a large, meticulously collected set of German newspaper articles (255 articles from 1997 to 2006) on the DPF debate which we obtained from one of the interviewees. These articles already provided a good overview of the positions taken by different actors in the case (e.g. automotive OEMs, NGOs, government) and of the important events. To supplement this source, we performed a series of text searches using LexisNexis, a major news retrieval database that covers a large part of the German newspapers and business press. To reduce the

risk of missing important information, we used a broad time frame (January 1985 until December 2007) and searched for articles containing the word "Diesel" in combination with important keywords identified from the interviews (e.g., "soot", "particulate matter", "health", "cancer", "filter", "Eolys", "inner engine", "no Diesel without Filter"). After the removal of duplicates, this search yielded 5112 articles. However, in most of these articles (particularly car reviews) the DPF is just a peripheral topic. Therefore, we eliminated car review articles and articles in which the keywords just emerged once (the scripting language Perl was used to perform this text-mining task). Finally, we restricted the scope to daily, weekly, and monthly periodicals with a larger circulation and of different political orientations (e.g., *Die Welt*, *Frankfurter Rundschau*, *Handelsblatt*, *taz*, *Die Zeit*, *Stern*, *Spiegel*). After narrowing the relevant time frame (see below), we arrived at a total of 1999 articles (approximately 1.3 million words and 5000 pages).

In addition, we augmented our understanding of the case by looking at scientific publications which address the DPF technology from a technical perspective (dissertations, conference proceedings, scientific journals), but refrained from including these documents in our frame analysis, because they do not report collective action frames.

Data analysis

To analyse the data, we used an open-ended approach (Strauss & Corbin, 1998). As we are investigating processes by which framing contests evolve over time and lead to institution creation, case narratives are indicated to capture the effect of time in our analysis (Langley, 1999). Consequently, we began by building a case narrative out of our interviews which were transcribed by a professional typist. This allowed us to evaluate whether we had a sufficiently interesting story to tell (Siggelkow, 2007) and to identify which aspects were more promising for a theoretical contribution.

We then ordered all available articles chronologically to obtain a reliable timeline of the events which constitute the case narrative. We established at this point that the case study would unfold from 1985 until June 2005, i.e. from the moment at which public attention turned to particulate matter emissions to the moment at which the social movement succeeded in creating a demand within Germany for the DPF (which ultimately forced car manufacturers to equip all their Diesel cars standardly with DPFs).

We then compared this timeline with the case narrative obtained from our interviews and adjusted it according to the written documents. This decision is based on the assumption that written documents are more reliable given that interviewees often have difficulties in recalling dates. Thus, this approach avoids chronological biases (Langley, 2009) and allowed for the triangulation of our data, thereby further substantiating our case study (Eisenhardt, 1989).

Once we had a case narrative, we used the frame analysis approach (Goffman, 1974) because it implies the systematic study of how actors deploy meaning to affect interpretation (Kaplan, 2008). In order to increase the likelihood of capturing interesting phenomenon, we coded our data along several dimensions, as shown in Table 1. To handle the huge amount of articles, we stopped coding at 30 articles per month in cases where when we reached a saturation point (Eisenhardt, 1989) i.e. when we realized that the same arguments were repeated and further reading would not provide new information. In total the analysis covered 577 articles.

Insert Table 1 about here

First, we had to identify from our material excerpts ("fragments" in table 1) which would constitute collective action frame. By collective action frame we mean the interpretation of an issue which is deliberately developed and carried out by proponents, opponents and their audience to "fashion shared understandings of the world and of themselves that legitimate and motivate collective action" (Snow et al., 1986). To perform this task, we first coded our data according to the typology of Benford and Snow (2000) to classify our material in terms of the

tasks the frames were accomplishing in the case study. This typology has a long tradition (e.g., Snow et al., 1986), is well-known (Davis et al., 2005; McAdam et al., 1996) and is extensively used in the organization theory literature (e.g., Kaplan, 2008; Weber et al., 2008). Fragments from written texts or the interview which identified a problem were coded as diagnostic frames. Excerpts which proposed a solution were coded as prognostic frames, and citations which invoked any kind of incentives to shape the behaviour of actors were coded as motivational frames.

We then classified these fragments along their polarity i.e. for (pro) or against (con) the DPF. The organization or who carried the frame ("who" in the table 1), the source of the fragments (i.e. from where the document was taken) and the date of the document from which it was taken were added in our coding to easily retrieve the material and to follow the chronology of events.

While coding our material, we realized that there were a myriad fragments and that we needed to make sense of this vast material. We followed a technique similar to the one developed by Gioia (e.g., Corley & Gioia, 2004) to identify the frames and the main themes alimenting the debates about the DPF. Each fragment was categorized along an increasing level of abstraction from first order theme, to second order theme and finally to the aggregate level (see table 1). The logic used to create cluster of themes having a higher level of abstraction was to pool together fragments according to their similarity, i.e. high similarity within a category, high dissimilarity between categories. Through this method, we could identify collective action frame which corresponds to the second order themes (e.g. "devaluation of diesel car without diesel filter"). We then identified six aggregated themes which correspond to the pooling of frames having related content. For example, the frame "devaluation of diesel car without diesel filter" was classified under the aggregate theme "economic risks and benefits" because it talks about the economic risks customers undergo if they buy or not a

Diesel car with or without DPF. The aggregate themes identified were: (1) public health issues, (2) risks and benefits of the technology, (3) behaviour (in)appropriateness, (4) cohesion/fragmentation, (5) regulatory intervention issues and (6) economic risks and benefits.

All themes emerged from the data and were not imposed from an outside framework (Agar, 1980). The material was coded iteratively by reading it several times and by adjusting and adding new codes as they appeared in the analysis. In practice, we systematically cut every single quote which we found in our material and pasted it into an MS Excel spreadsheet. MS Excel has the obvious advantage over dedicated coding software (such as NVivo) that it contains the pivot table function which instantly builds synthetic tables.

Because matrix display has the advantage of synthesizing large amounts of data (Langley, 1999; Miles & Huberman, 1994), our coded material was then organized in two columns according to their polarity with the frames (second order theme) in favour of the filter (pro) and those against it (con) along a time lime. This method allowed us to identify which framing contests was taking place when and around which theme. A selected sample of these frames and their polarity are presented in Tables 2, 3, 4, and 5. They provide several examples of how matrix display was used and how frames were coded.

Phases emerged from our analysis as we were coding the material. We realized that there was a significant change in the themes around which framing contests were taking place or in the activities of the social movement. We used these change to delimit our phases. More specifically, the necessary opening phase constitutes the first layer of framing contests and was mainly constituted of diagnostic and prognostic frames. Our second phase (organizing-mobilizing phase) was clearly featuring a key event, namely the organization of the social movement and the concomitant new layer of framing contests which appears in the data in November 2002; as the social movement mobilized more intensively frames having a motivational task, namely the cohesion/fragmentation and the behaviour (in)appropriateness

themes. The third phase (Instrumentalization of channels) grew out of the two previous layers and consisted of the themes economic risks and benefits and regulative intervention issues.

CASE STUDY: THE DIESEL PARTICULATE FILTER IN GERMANY

The necessary opening phase (January 1985 – October 2002)

The First Debates (1985 to 1999). In the nineteen eighties appeared the first scientific publications which investigated the health effects of airborne particulate matter (PM). Several of these studies suggested that an exposure to ambient PM increases the risk of various adverse health outcomes such as asthma, heart failure and throat or lung cancer (Dockery & Pope, 1994; Kaiser, 1997; Schwartz, 1991). In 1989, the International Agency for Research on Cancer (related to the World Health Organization) rated Diesel engine exhaust gas as "probably carcinogenic to humans" (International Agency for Research on Cancer 1989: 42). At that time, NGOs in Germany started to turn their attention to Diesel cars and identified their PM emissions as a major public health problem. In addition, during the nineteen nineties, the propagation of Diesel direct injection technology led to an increase in the emission of ultrafine particles which pass through the human lung, enter the bloodstream, and accumulate in organs e.g. the brain, leading to increased risk of cerebral infarction:

> *"...with the injection technologies of Diesel fuel into the combustion chamber, particulate matters became smaller and smaller. We have micro-particulates of nano size which can enter not only the lungs and its capillaries, but also could enter the bloodstream and end up in the brain." (Environmental activist)*

Against this background and since the PM concentration in many inner city areas regularly exceeded the limits set forth in the early air pollution standards, some environmental NGOs (e.g., Greenpeace) requested the automotive industry and politicians to develop solutions for the Diesel PM issue. The car manufacturers reacted by questioning the negative effects of Diesel PM on human health:

> *"Latest research from the US-Health Effects Institutes shows that there are no measurable effects of the exhaust of modern Diesel engines on health" (Managing director of the German automotive industry association)*

Specifically, it was argued that Diesel exhaust's contribution to the overall PM concentration in the atmosphere is small. Since exhaust after-treatment systems were already available for Diesel trucks, members of the environmental movement suggested R&D into DPF technologies (e.g. Greenpeace, 1993). In response, the car manufacturers stressed the technological challenges, costs, and trade-offs associated with DPFs:

> *"The industry was saying that Diesel particulate filters are not necessary, it's not possible, it costs too much money." (Government representative)*

Peugeot's Diesel Particulate Filter (1999 to 2002). Sensing an opportunity to gain a competitive advantage in the German car market, the French automotive OEM PSA Peugeot Citroën presented a Diesel car model with a DPF (Peugeot 607 HDi FAP) at the 1999 Frankfurt Motor Show and launched the model in early 2001 in Germany. Overall, the car fulfilled only the current Euro 3 norm, but emitted very little PM due to a filter system (FAP) developed by Faurecia, a French supplier in which PSA held a majority stake. At that time, this was the only Diesel car available with DPF in Germany. Interestingly, PSA targeted the German market *exclusively* with their DPF system (officially, the DPF was also launched in France, but it was hardly available there). The launch was accompanied with a marketing campaign including three major TV commercials which compared the "clean" Peugeot with the "pollutant" German Diesel cars. The marketing campaign increased public awareness of the Diesel soot issue and demonstrated that filters were effective and technologically feasible.

In response to PSA's aggressive marketing campaign, the German car manufacturers argued that the employed filter technology was ineffective because it required a special chemical additive ("Eolys") which would be more pollutant than the Diesel exhaust itself and because the filter needed to be replaced every 80.000 km. Besides, they continued to maintain that there was no solid evidence supporting the adverse health effects of Diesel PM:

> *"there is a lack of scientific evidence for the interaction of particulates and its effects on human health. I doubt that results from rat tests are informative for human health. Epidemiologic studies*

are lacking and need to be conducted" (Corporate Representative from a major car manufacturer).

Due to the dispute, environmental NGOs asked the largest German automobile club (ADAC) to assess the effectiveness of PSA's DPF technology. ADAC performed two tests comparing the DFP-equipped Peugeot with a similar-sized German car model (Mercedes E220 CDI). In both cases, the tests indicated that the DPF reduced PM emissions to almost zero. In reaction to these tests, the German car manufacturers argued that, in contrast to the Peugeot model, most of their Diesel cars already attained the stricter Euro 4 norm and that the one-sided debate on PM would oversimplify the problem:

"The filter might solve some problems but increases new ones, such as [fuel] consumption […]" (CEO of a major car manufacturer)

They also pointed out their own R&D efforts on internal engine methods to reduce Diesel PM and claimed that this approach was technologically superior to after-treatment solutions.

In March 2002, in the face of the German car manufacturers' persistent inaction and denial, some NGOs began campaigning more intensively to attract public attention on the PM issue. Some members of the environmental movement met with the German car manufacturers to state that the NGOs would "go to war" if they would not introduce DPFs. In September 2002, the failure of these negotiations brought some NGOs (Greenpeace, DUH) to reiterate the adverse health effects of Diesel PM and the advantages of DPFs. However, the position of the car manufacturers did not change:

"The German automotive industry considers internal engine solutions to be a smarter approach than after-treatment, because it avoids the production of particles". And "The utilization of filter systems leads – according to the current state of technology – to higher fuel consumption, higher costs and requires special maintenance in order to clean the system from residues" (VDA, German Association of the Automotive Industry, November 25, 2002)

In parallel, the environmental activists and PSA (who in the meantime had also introduced the DPF system in several other model series such as the Peugeot 307 and 406) were lobbying the

German government to provide tax incentives and to criticize the inappropriateness of current European exhaust emission standards, because the air quality standards were often violated.

Frame Analysis. Following Benford and Snow's typology (2000), most frames within this initial phase can be grouped under two core framing tasks: Diagnostic and prognostic. The conflict began with the activism of a few environmental NGOs which – based on the results of several scientific studies – diagnosed the Diesel PM as being probably dangerous for human health (e.g., carcinogenic, entering the blood stream and brain). This set of diagnostic frames which revolved around the identification of a public health problem was counter-framed by the car manufacturers as not being an issue because there was no sufficient scientific evidence that PM emitted from Diesel engines have an impact on human health. Since DPFs existed for trucks (although based on a different technology), the environmental NGOs elaborated a prognostic frame (a solution) which was counter-framed by the car manufacturers by arguing that DPFs for cars face too many technical challenges, are too costly and overall not necessary to attain the forthcoming (in 2005) Euro 4 norm. Their technology pipeline focused on internal engine methods to comply with Euro 4. Thus, in the beginning of this phase, we find mainly *public health issues* and *technological risks and benefits* as the dominant frame themes.

The prognostic framing activity gained significant momentum with the market launch of Peugeot's DPF-equipped car. Suddenly, the technological infeasibility arguments of the German car manufacturers were refuted and the solution suggested by the environmental activists evolved from a potential to a viable solution. The German car manufacturers counter-framed this new development by discrediting PSA's DPF technology (e.g., generally ineffective, not reliable, more polluting due to the chemical additive). The framing gained further in intensity with the large and well-respected automobile club ADAC running rigorous tests and "proving" the effectiveness of Peugeot's DPF technology. We refer to this

progressive evolution of the prognostic frames' intensity (i.e., from a potential technology to a viable solution based on substantial evidence) as *frame polarization*.

Finally, a new type of framing task appeared in October 2001 with the German car manufacturers arguing that DPFs increase fuel consumption, a (de)motivational frame (Benford & Snow, 2000) which aims at impeding any form of mobilization with the environmental NGOs. The theme of this frame is related to *economic risks and benefits* because it addresses the costs that customer would incur if they bought a car with DPF. Table 2 summarizes the main frames and counter-frames which were mobilized over time by proponents and opponents of the DPF during this phase. At the end of this phase, the environmental activists perceive that they have legitimate diagnostic (Diesel PM as a significant public health problem) and prognostic frames (the DPF as a viable solution) which are stonewalled by the car manufacturers. This sets the stage for the subsequent framing contest.

Insert Table 2 about here

The organizing and mobilizing phase (November 2002 – February 2004)

Formation of a Coalition. In November 2002, a coalition named "No Diesel without filter" (originally: "Kein Diesel ohne Filter") was officially created under the leadership of DUH (German Environmental Help) and joined by the major German environmental NGOs (BUND, DNR, Greenpeace, NABU, VCD). The initial coalition grew rapidly and finally also included the WHO (World Health Organization), the German Child Protection Association, ADAC, as well as 97 smaller NGOs. Creating a coalition was considered to be one of the few measures which might make the German car industry move. In this vein, a government representative stated that "only a coalition has the strength to go against the power of the car industry." The aim of this coalition was to "promote the rapid and widespread installation of particulate

filters in order to fight against diseases induced by Diesel soot" (internal document). While health problems were invoked to justify the use of a DPF, the fact that the French competitor PSA could introduce the technology was also an argument brought forward by the pro-DPF coalition: "if the French manufacturers did it, the German manufacturers can also do it."

In December 2002, in order to support their claim that Diesel PM is dangerous for human health, the coalition started their campaign with a press conference where they conducted an experiment with two German Diesel cars– one equipped with a DPF (provided by Faurecia), the other without. The following quote describes the experiment which was run by a three-year old child:

> *"So we could show that if you monitor the emissions of a normal Diesel car with a normal paper tissue, it is still white after half of a minute. This gives the impression that the car is clean. Then, the child used a white special particulate filter tissue. It became black in seconds. It was really impressive. With this experiment, we could show that even a paper tissue cannot block extremely small particulates and that we need a special tissue with extremely small structure to block them." (Environmental Activitist)*

Fragmenting the Automotive Industry. After this public demonstration, the pro-DPF coalition approached various German car manufacturers to offer their support in exchange for the introduction of the DPF in their fleets by mid-2003. Ford Germany was the only one inclined to talk to the coalition and even negotiated with PSA/Faurecia the supply of DPF modules. In order to reward and motivate Ford Germany, the coalition gave a red card (in analogy to being sent off the field in soccer) to each German car manufacturer except for Ford Germany which received a yellow card (in analogy to receiving a warning in soccer). Just after it received a yellow card, one of the top managers of Ford Germany called a member of the coalition and asked to receive a red card as well because all the CEOs of the German car manufacturers were angry that Ford Germany had accepted in order to obtain a competitive advantage with the filter and threatened Ford Germany with isolation from the German Car Manufacturers Association. One member of the coalition recalls:

> *"Within two hours, I got a phone call from the office of the director of Ford Germany. The assistant of the CEO told me: 'Mr Y, you can't imagine what is happening. Every five minutes we*

> *get phone calls by the other CEOs of German car manufacturers. They are telling us that the alliance at German Association of the Automotive Industry [VDA] in Frankfurt is broken for [Ford Germany]. We have to ask you to give us a red card like the others [car manufacturers] because we have to cancel our order to PSA for particulate filters. I know it's absurd to ask PSA to reconstruct that engine without particulate filter, although this engine was only available in a series production with particulate filter, but [Ford Germany] doesn't want to be leader with the filter, we want for the years to come to make motors without particulate filters. Otherwise the alliance with all the others [car manufacturers] is endangered." (Environmental Activist)*

While there was strong pressure inside the automotive industry to stay united with and loyal to the majority of car manufacturers (assembled in the VDA i.e. the German Association of the Automotive Industry), in July 2003 the Federal Environment Agency (UBA), Germany's central federal authority on environmental matters, published an epidemiologic study which estimated that 14,000 people were dying each year in Germany due to the emission of traffic-related PM. In August 2003, another German car manufacturer announced that it could readily install DPFs on some of its car models, but it hesitated to be the first mover.

At the same time, the environmental movement made attempts to mobilize DPF suppliers (competitors to Faurecia), who had considerable interest in the success of the campaign in order to expand their market (*Handelsblatt*, August 6, 2003). Later, it turned out that certain DFP suppliers even supported the pro-DPF coalition with funds. In response, German car manufacturers threatened to terminate or curtail their supply contracts with these suppliers if they kept on collaborating with the environmentalists. In parallel, various seminars were held by lung specialists with the aim of informing the public about the consequences of Diesel PM.

In September 2003, on the occasion of the International Automobile Show (IAA) in Frankfurt, the German car manufacturers jointly announced that they would offer DPFs for all cars at the earliest (effectively until mid-2004). The position of the car manufacturers was: "we will do what the market asks." However, as they still focused on complying with the Euro 4 norm (and not on reducing PM per se), the DPF would only become standard equipment for cars with larger Diesel engines (> 2.5 litres). For smaller engines, the car manufacturers intended to offer DFPs only as an optional extra (at an extra charge of 500 to 1,000 Euros), because the

norms were easily attainable without DPF. Therefore, the settlement – reached between the German Government and the VDA – was considered as insufficient by the pro-DPF coalition.

Frame Analysis. This second phase starts with the constitution of a coalition formed with the joint goal to promote the DPF as a technological de facto standard. This organization allowed the proponents to increase the credibility of their frames (because the coalition covered a broad range of different members of society, e.g., environmental NGOs, ADAC, WHO) and to obtain access to additional resources.

Given their new power, the coalition attempted to "proselytize" members of the automotive industry. This lead to the creation of new *cohesion/fragmentation* frames which were not present in the previous phase. Indeed, the car manufactures faced challenges to maintaining their cohesion as Ford Germany and the DPF suppliers were ready to cooperate with the environmental movement. Obviously, automotive suppliers who had discretion over DPF technology had incentives to break apart and support the DPF campaign more or less overtly. Likewise, Ford Germany searched for ways of getting the DPF technology into its car models. In the first instance, the industry could frame arguments to restore cohesion by threatening to terminate/curtail their relationship with some suppliers and Ford Germany.

The car manufacturers did not directly counter-frame the result of the experiment conducted by the three-year old child which showed that filters are effective. Instead, the car manufacturers responded by stressing that it was inappropriate and abusive behaviour of the DPF proponents. Thus, facing the prognostic frame "effectiveness of the filter," the car manufacturers opted to respond with a motivational frame, i.e. the experiment was abusive because it involved a little child. Likewise, they accused the environmental movement of behaviour inappropriateness when the movement brought the frame that Diesel PM kills 14,000 people per year. They dismissed this frame as "panic mongering." This suggests an

asymmetric framing contest where the reply does not directly address the content of the frame, but rather attacks the integrity of the people involved.

Insert Table 3 about here

There is also a cumulative effect of previous frames. Indeed, the *technological risks and benefits* and the *public health issues* were present in previous episodes and were still valid and activated in the interplay of actors in 2002. We observed also a polarization i.e. an intensification of the *public health issues*. Indeed, frames describing the effect of Diesel PM in terms of causing health problems in March 2002 were invoking the number of deaths in November 2002. Table 3 summarizes the main frames and counter-frames which were mobilized during this episode.

Finally, the car manufactures gave a little bit in by agreeing to offer DPFs for all cars. However, since they still did not offer the DPF as standard equipment at no extra charge, the debate remained unsolved.

The instrumentalization of channels phase (March 2004 – June 2005)

At the federal level, the pro-DPF coalition and the car manufacturers were both struggling to persuade the federal government to support them. The industry organized lobbying activities to reach the Green party and the Social Democratic Party (SPD) both of which were in power at that time. The coalition was also active in terms of lobbying and involved in hearings at the German parliament where NGOs, WHO, physicians and children's associations were presenting public health arguments (by invoking the number of deaths related to Diesel PM) and were militating in favour of the DPF. In March 2004, only three hours after the Green party and the SPD considered that tax incentives to promote DPFs could be an option, the CEO of Volkswagen wrote a private letter to the government which said: "if you force the

[car] manufacturers to use this technology [DPF], you will kill the German Diesel industry" (*Automobilwoche*, April 25, 2005).

At this point, the environmental movement had gained sufficient legitimacy to be able to use economic arguments and be perceived as credible. Indeed, they largely disseminated the result of a forecast study (conducted by EurotaxSchwacke, but commissioned by the Federal Environmental Agency) which concluded that Diesel cars which were not equipped with DPFs would be devalued by 500 to 2,000 Euros depending on the brand and the type of car. This evaluation had an enormous impact on customer behaviour as leasing companies began having difficulty selling cars without DPF and customers were asking for the DPF:

> *"We commissioned a study and it concluded that the value of a car without a filter would be about 500 to 2,000 Euros lower [than a car with a filter] after five years. Our conclusion alarmed leasing companies because they rely on the value of used cars to resell their cars. [...] So, leasing companies made a calculation on the value of cars after the leasing period. If the value is going down, of course, they have a big loss of money. If you buy 100,000 vehicles and each vehicle loses 2,000 Euros above average, you lose a lot of money. The study was conducted by a company which evaluates the value of used cars. It was expected that they would publish reports stating that the value of a used car without a filter would be about 500 or 2,000 Euros lower depending on the type of the car. It was the end of the debate." (Government representative)*

As the pressures from the coalition and the public increased and were reflected weekly in the lay press, politicians were closely interested in how this issue was developing. Initially, the government thought that introducing a tax incentive could be a viable option, but the trend of the market was suggesting that there was no longer any need for this:

> *"The idea was to give a tax incentive to customers, but in the end there was no need because if the market for Diesel cars without filter vanished it would have been useless [to provide incentives]." (Government representative)*

Car manufacturers who did not have contracts with DPF suppliers saw their share in the Diesel car market dropping and had to invest heavily in increasing supplier capacity (particularly in Japan). Indeed, the problem was that even though the car manufacturers wanted to offer DPFs, there was not enough supply to equip the large annual volume of German Diesel cars. The Head of the engineering department of one of the major car manufacturers commented:

> *"And then something happened that we didn't expect. Because it had been pushed in the public that those cars [without filter were undesirable], by then called the 'smokers' in contrast to 'non-smokers,' the customers took a 'bad' attitude [by asking for filters]. This was completely astonishing for us because we realized for the first time that this debate on particulate emissions was more an emotional thing than a rational one. And this emotional effect surprised us a little bit that is why we were late to react."*

Frame Analysis. While we still observe the process of framing and counter-framing based on established themes such as *public health* issues and *technological risks and benefits*, this last phase is characterized by a major change, namely the involvement of both the government and the customers. Two important frames of the pro-DPF coalition were critical in activating these groups as channels to exchange frames.

First, based on the obtained media attention, the coalition disseminated the frame "many people die in Germany because of Diesel soot particulates" which was derived from a credible study commissioned by the Federal Environmental Agency. This frame attracted government attention and triggered a discussion of how to motivate customers to buy cars with DPF (ranging from banning Diesel cars from inner cities to tax incentives). The car manufacturers tried effectively to counter-frame this by reminding the government that such legislation would seriously hurt the German car industry, threaten many jobs, and after all be inconsistent with European law. While the *regulatory intervention* frame was already voiced earlier by the DPF proponents, what is specific at this phase is that this frame was powerfully counter-framed by threatening the government that tax incentives could "kill" the Diesel car technology in Germany.

Once the discussion on DPF incentives for new cars was established in the media coverage, the proponents were able to craft the second important frame, "economic value of the car", which called the resale option of Diesel cars without DPF seriously into question. Although it was not yet clear which direction the legislation would take, this motivational frame (supported by the study of a market research firm who is a very credible specialist for the calculation of residual values) made the customers suddenly pay attention to the DPF issues

and the arguments from the proponents. Moreover, the frame "economic value of the car" was increasingly polarized. The framing started from "cars without filter will lose value" and ended in the notion that reselling cars without DPF would become almost impossible in the near future.[3] This resonated with the customers, because the frame conveyed *individualized negative consequences*. The strong frame "economic value of the car" dominated the media and made the customers "pull" the DPF technology from the car makers. The summary of this phase is shown in Table 4.

Insert Table 4 about here

ANALYSIS

Polarizing framing contests

Often treated as static in the literature, our results show that frames develop over time since proponents and opponents of the DPF adjust their arguments according to the evolution of the war over the DPF. Accordingly, our case suggests that, as attempts to convince manufacturers of the automotive industry, suppliers, consumers and the government failed, the social movement elaborated stronger arguments in order to achieve their goal i.e. making the DPF a standard for Diesel cars. Manufacturers reacted to these attacks by crafting counter-frames which also became more extreme. This dynamic led to a phenomenon which we call *frame polarization* because the arguments of both the proponents and the opponents of the DPF

[3] It has to be noted that several suppliers offered affordable DPF retrofitting kits. However, according to experts, these kits are so-called "(half)open systems" which attain only 30 to 40% of the effectiveness of original equipment DPFs. For this reason, retrofitting was not an option to circumvent the economic loss.

became increasingly extreme and evocative over time. Since the polarization occurs for both parties, we can state that not only frames but also the framing contests are polarizing.

The polarization phenomenon is substantiated in different manners in the case study and on several collective action frames. For example, the collective action frames which are related to *public health issues* performed a diagnostic framing task because they identified a problem that had to be solved. Independent activists, and later on the social movement for the DPF, first argued that particulate matter emissions were carcinogenic, then added another line of argument by stating that Diesel soot particulates increase the number of deaths and constitute a risk for children, and finally provided an estimate of yearly deaths related to these emissions. This polarization phenomenon was nurtured by the reaction of the opponents of the filter (members of the automotive industry) who continued to deny that soot particulate emission was a public health issue. They first argued that there was a lack of evidence and then they denied the validity of the evidence by questioning the generalizability of the studies on rats to human beings. Later on, confronted with the argument about the estimated number of deaths, opponents of the filter changed their approach by beginning to question the appropriateness of the behaviour of the environmental movement, accusing them of panic-mongering. Table 5 displays the polarization of the frames of the four main themes on which actors engaged in framing contests, namely public health issues, risks and benefits of the technology, economic risk and benefits and regulatory intervention issues.

Insert Table 5 about here

Frame polarization was also observed in our data in the framing contests related to *risks and benefits of the technology* which accomplished a prognostic framing task (identifying a solution) in our case. Before 1999, the proponents of the filter initially argued that the filter technology offered a potential solution. With the commercialization by Peugeot of cars with the DPF in Germany, this technology was no longer framed as a potential solution but became

a viable commercial one. After the test of the automobile club (ADAC), the filter was framed as an effective evidence-based solution. This line of arguments corresponds to a frame polarization because framing passed from a potential solution to a commercial one (which, however, is not a proof of its effectiveness) and an evidence-based solution. In this framing activity, each argument increases the legitimacy of the technology. This framing of the filter was counter-framed by the automotive industry members as an ineffective technology and with the commercialization of the Peugeot's filter as a technology which is actually even more polluting (note the paradox here).

In 2001, new frames related to the theme of *economic risk and benefits* accomplished a motivational framing task because they provided rationale for customers to engage in the social movement through their purchasing power. These frames were attempting to influence the perception of customers over the costs or savings a DPF would incur. At first, opponents of the filter argued that this technology increases fuel consumption which translates to customers as increasing the cost of driving. This argument was counter-framed by the environment coalition which claimed that there was no effect on fuel consumption. Later on, the environmental coalition counter-attacked by arguing that cars without a filter would see their value drop by 500 to 2000 Euros. This economic frame was counter-framed by the automotive industry by denying such a claim. Again, in this case, this framing contest polarized because the financial implication of having or not having a filter increased over time from a few Euros when fuelling to hundreds of Euros when reselling used cars.

The framing activities related to *regulatory intervention issues* were also meant to accomplish a motivational framing task because these aimed at changing customers' behaviour through tax incentives. Whereas the environmental coalition was asking for tax incentives, the automotive industry members polarized their frame when politicians began talking seriously about introducing a tax incentive. The CEO of one of the major car manufacturers sent a letter

to the government explaining that tax incentives could "kill" the Diesel car industry in Germany and might "kill" its technological edge which focused on internal engine measures. Clearly, this position manifests a polarization of the position of the industry by using threat.

From this analysis, our results suggest that frame polarization is not an isolated phenomenon since it is reflected in the three core framing tasks, namely the diagnostic, prognostic and motivational framing tasks (Benford & Snow, 2000) and it occurs on both sides of the conflict. Given that the frames of both proponents and opponents of the DPF became more polarized and consequently that the framing contests themselves also became more extreme, our results suggest that frames and framing contests are not static but develop over time. In our case, frame development took the form of frame polarization which seems to have occurred because previous struggles did not lead to the expected outcome i.e. making the DPF a by-default technology in Diesel cars.

Cumulating phases

Our data suggest that in order to creation a new standard, i.e. the DPF, a cumulative mechanism is at play. Different phases characterized by different framing contests cumulate over time and form the necessary conditions for the resolution of a conflict. This phenomenon is similar to a sedimentation process where the older phases or layers of framing contests are still active when new phases begin. In order for framing contests to endure over time, some activities have to take place first on which other framing activities from the opponents and proponents of the DPF sediment. As such, initial debates or framing contests are a prerequisite for further framing activities to take place. By organizing these framing contests in phases (see the methodology section for further details on how we defined these phases), we observe that the *necessary opening* phase constitutes the foundation of the conflict and is a necessary condition for the *organizing-mobilizing* phase or the *instrumentalization of*

channels phase to occur. Table 6 provides an overview of the cumulative effect of social movement activities in which framing contests play a crucial role occurring over time.

Insert Table 6 about here

Necessary Opening Phase. The first phase is characterized by framing contests over two dominant themes which constitute the necessary conditions for further framing contests to take place. The first framing contests within this phase consisted essentially of fighting over the existence or non-existence of public health issues (diagnostic framing and counter-framing tasks) and on the effectiveness/ineffectiveness of the DPF in lowering the particulate matter emissions (prognostic framing and counter-framing tasks). If no problem or no solution had been identified; there would have been no need for the social movement to engage in institutional war with the automotive industry to promote a new industrial standard i.e. the DPF. In other words, for an institutional war to occur, it is necessary that a problem has been identified and a corresponding solution is available.

Organizing and Mobilizing Phase. Although framing a problem and a solution are the necessary conditions for an institutional change to take place, our case suggests that these necessary conditions are not sufficient, otherwise the DPF would have become standard in Diesel cars when Peugeot commercialized its filter and when carcinogenic evidence was available. Frames need credible carriers to gain legitimacy. The coalition was formed out of very influential NGOs from different sectors such as medicine (WHO), child-care associations and other environmental organizations (such as Greenpeace). The formation of this coalition came about because the diagnostic and prognostic collective action frames of this necessary opening phase constituted the basic ingredients for 97 social movement organizations to work together. Without such a powerful coalition, it is unlikely that further frames developed or carried from the coalition would resonate and generate institutional change. During the same phase, the social movement attempted to fragment the German

automotive industry by mobilizing car manufacturers and suppliers. For example, when the environmental movement approached the manufacturers of DPF (the first-tier suppliers of the car manufacturers) to collaborate with them, these suppliers provided the movement with a substantial amount of financial resource to lead their war. However, the car manufacturers wielded their power and threatened these dependent suppliers with the termination of their contracts if they continued to work with the movement. In this example, it is clear that the environmental movement found allies within the automotive industry, although the suppliers were forced to withdraw from any activity with the movement. Another example comes from the action of the environmental movement to encourage Ford Germany to use PSA Peugeot's filter in their cars in exchange for their support. The support was then to attract a lot of media attention by giving red cards to all car manufacturers except for Ford Germany which received a yellow card. However, as the case shows, strong internal forces were at play to bring Ford Germany "back on track" and it had to renounce. Behaviour inappropriateness was also pinpointed by both factions to discredit opponents as a way to increase cohesion within the automotive industry.

These attempts by the social movement and the automotive industry to discredit or fragment the opponents constitute a form of cohesion testing as strong internal counter-forces were mobilized, especially on the part of the automotive industry, to ensure the cohesion of such central players of the industry as major suppliers and Ford Germany.

Activities of this phase served to feed the next phase as the coalition built a solid credibility and there were some indications that some central actors within the automotive industry were ready to provide their support. From then on, this institutional war was taken to another level by attempts to mobilize alternative channels i.e. the customers and the government.

The Instrumentalization of Channels Phase. Whereas in the preceding phases the social movement engaged directly with the automotive industry, the mobilizing outsiders phase is

characterized by a change in the offensive strategy of the environmental coalition. In order to achieve their goal of bringing about new industrial standards (i.e. the generalized use of DPF in Diesel cars), the environmental movement began attempting to mobilize alternative channels (customers and the government) to join the social movement. While government intervention could have led to the introduction of tax incentives to promote the use of the DPF, influencing customer norms by framing the negative individualized economic consequences of not having a DPF dramatically affected the demand for the DPF technology. These channels have the capacity to affect the automotive industry through customer purchasing power or regulation. This shows that in order to induce change in society, direct confrontation through framing might not be the most efficient tactic.

Although the sequence of these phases was observed from our empirical material, they follow a logic. Indeed, engaging in a framing contest presupposes the necessary conditions of having a problem and a solution (necessary opening phase). However, our case suggests that having elaborated a problem and a solution is not sufficient to mobilize people to engage in a social movement. Credible carriers and developers of frames have to organize in order to create a critical mass of activists which are supporting this institutional project. Once this coalition was built, the social movement attempted to fragment the automotive industry by mobilizing central players, but strong counter-forces came into play to prevent this industry from fragmenting. If there would have not been such cohesive forces within the German car industry, the DPF could have been a source of competitive advantage for Ford Germany and could have forced other players to join the movement. However, it indicated that some constituents of the industry were ready to join the movement but other actions had to take place and other constituents had to be reached through motivational frames.

The first two phases constitute the foundation for further framing contests to take place and to generate a new *de facto* standard. Indeed the first two phases provide the basic ingredients for

a war on an issue by providing the diagnostic and the prognostic frame and by generating strong frame carriers to mobilize organizations from different sectors including the attempt to mobilize central organizations from the automotive industry such as the main suppliers and one important car manufacturer. Thus, the phase instrumentalization of channels accumulates onto the two precedent phases and sets the scene for new motivational frames to resonate in alternative channels. At this point, the DPF was not perceived as necessary. It is when the social movement elaborated a collective action motivational frame having negative individualized economic consequences that a new norm emerged.

The economic benefit of the filter to consumers took time to establish, having first to show the legitimacy of the technology through various tests (ADAC, the experiment with the little girl, the scientific community, etc.). During this period, there were signs that some central players were ready to adapt and that expensive cars would have a filter. It was only under these conditions that the instrumentalization of channels phase could bear fruit, making the DPF a necessary item of equipment.

These phases are cumulative because the motivational frames “devaluation of the Diesel cars without DPF” would not have had the power to generate a new standard without the prognostic and diagnostic frames, and without the powerful coalition carrying it. While the sequence of phases appeared in this order in our data, it is important to note that these activities might also appear in different sequences in other settings.

Motivational framing tasks having negative consequences

By looking at both sides of the interaction, we found that it is not only motivational frames which provide rationales to engage in social movement: opponents also develop their own frames to impede people from engaging in social movement. For example, the automotive industry was framing the DPF as increasing Diesel consumption or was arguing that not having a DPF would not affect the value of the car. Therefore, it is more accurate to state that

there are motivational and demotivational frames which counter-balance each other's effect. This suggests that in order to understand how resonance works, studies should focus on both sides of the interaction i.e. the collective action frames developed by the proponents and opponents of a cause.

Why did the collective action frames of the necessary opening and the organizing-mobilizing phases not succeed in mobilizing actors to engage in the movement? What is surprising is that even extremely polarized diagnostic frames such as the number of deaths yearly caused by particulate matter emissions were not sufficient to mobilize customers or to make the industry more receptive to the DPF. One reason which can be invoked is that this collective action frame does not provide individualized consequences to customers or the industry to produce or ask for DPF technology, thereby not accomplishing a motivational task. In other words, this frame is statistical and does not point to who is going to die. Another reason is that these frames were counter-framed by the industry accusing the environmental movement of panic-mongering. This could annihilate the effect of the frame of the social movement. For example, in the second phase, the automotive industry provided a demotivational frame to consumers by stating that the DPF could increase Diesel consumption which was accompanied by a denial from the social movement. This demotivational frame stated the negative consequences related to having a DPF in a Diesel car.

At this point, the environmental movement did not provide a strong motivational frame to mobilize actors outside the movement-industry relationship. Interestingly, it is only the frame "devaluation of the car" which resonated with the customers. We argue that this frame was effective because it provided negative individualized evidence-based consequences of not having the DPF (motivational task) which started to be perceived as a problem by customers and it was not substantially counter-framed by the automotive industry.

Three reasons can be invoked to support our claim. First, the frame "devaluation of the cars" provided individualized consequences of not having a DPF, thereby accomplishing a motivational task. As previously stated, the diagnostic frame on public health issues, such the number of deaths, does not address the individual directly but as anonymous consequences given that nobody knows who is going to be a victim or who the losers are. In the case of the frame "devaluation of the car", we know exactly who would lose i.e. buyers of Diesel cars which represent around 50% of the cars sold in Germany.

Second, the polarity of the consequences matter. In this case, the "frame devaluation of the cars" had important negative consequences because people could lose up to 2000 Euros on the reselling price. Those who were the most affected by this were the leasing companies. Because not having a DPF had negative consequences, it began to be perceived as the problem to be addressed by Diesel car buyers.

Finally, the frame "devaluation of the car" was evidence-based and quantified. Stating that people would lose between 500 to 2000 EUROS if they bought a car without filter was a powerful means to substantiate the claim. In contrast, this frame was only weakly counter-framed by the automotive industry. They counter-argued merely by denying the arguments of the environmental movement, defending the position that not having a filter did not affect the value of the Diesel cars.

Interestingly, the frame developed by the automotive industry during the second phase and related to increased Diesel consumption, played a similar role but in favour of the automotive industry as they developed frames having negative individualized consequences and were also weakly counter-framed by the environmental movement through denial.

Overall, the turning point in the case study came when the social movement developed the frame based on the theme *economic risks and benefits* which develop frames around the idea that cars without DPFs would be devalued in the future (a negative individualized evidence-

based consequence). This brought a change in customer norms, notably of leasing companies, as they began asking for DPFs when buying Diesel cars in order to avoid losing money. To avoid losing their market share, car manufacturers had to adjust quickly and those who did not have contracts with filter suppliers lost out. Due to the demand for DPF, car manufacturers began offering this equipment as standard on Diesel cars.

DISCUSSION AND CONCLUSION

While framing contests and their impact on the emergence of institutions has received attention, studies that examine how proponents and opponents involved in framing contests shape collective action frames over time is scarce. To address this issue, we drew on an in-depth case study of the environmental movement for the DPF in Germany.

Our study highlights the fact that different phases of framing contests cumulate over time. The necessary opening phase constitutes the first layer for a conflict to take place over an issue as it is characterized by contests over diagnostic (identification of a problem) and prognostic (identification of a solution) frames. We argue that this first phase is the necessary first layer because without an initial problem and a solution, there would be no reason to engage in a conflict. We found that the subsequent organizing and mobilizing phase sedimented onto the previous one and was characterized by the organization of the social movement through the creation of a broad coalition and by its attempts to mobilize central actors of the automotive industry in order to fragment it. The instrumentalization of channels phase was the last one to sediment on the two precedent layers. This phase features the emergence of frames related to the devaluation of Diesel cars without filter and the mobilization of alternative channels such as the customers. We argue that this frame resonated because it involved negative individualized evidence-based consequences. This frame is powerful because it applies to everyone who intends to buy a Diesel car, because it has important negative consequences which are financial in that case and the social movement provided evidence to support their

claim. In contrast, the claims of the opponents of the DPF simply denied the collective action frame of the social movement without proposing other consequences and without supporting evidence. Their framing activity did not convince the customers who began exercising their purchasing power by asking for the DPF, thereby forcing the German automotive industry to make the DPF a *de facto* standard – although unnecessary from a regulatory perspective (most of their cars complied with the effective Euro 4 norm *even without* DFP). We believe that it is capital for motivational frames depicting negative individualized evidence-based consequences to sediment on solid ground composed of diagnostic and prognostic frames carried by a strong social movement. Furthermore, we found that framing contests evolve over time through an increased polarization of arguments, in our case, by the proponents and opponents of the DPF, thereby reflecting an increasing intensity of the conflict.

Frame polarization

While most previous studies document how social movements shape their own collective action frames without exploring the counter-framing activities of their opponents (e.g. Clemens, 1993; Lounsbury, Ventresca, & Hirsch, 2003; Markowitz, 2007; Rao et al., 2003; Schneiberg & Soule, 2005; Sine & Lee, 2009; Weber et al., 2008) – or when they are doing so, failing to document how framing contests evolve over time (e.g. Creed et al., 2002; Suddaby & Greenwood, 2005) – our study extends previous work in the social movement literature which used framing contests to document the emergence of institution by looking at both sides of the interaction (proponents versus opponents). Our study also extends the literature on institutional entrepreneurship which has mainly developed actor-centric narratives in which the action of institutional entrepreneurs is extensively documented to the exclusion of other actors (Wijen and Ansari, 2007), notably those who resist change (Hardy & Maguire, 2008). While these studies offer an invaluable contribution to our understanding of the emergence of institution, they fail to examine explicitly how framing contests involving

actors with extremely divergent interests evolve over time and how these struggles are associated with the emergence of institution (Benford & Snow, 2000; Hardy & Maguire, 2008; Hargrave & Van de Ven, 2006).

Our analysis shows that frames and framing contests develop over time. In our case, frames and framing contests developed towards polarization. Polarization reflects an increasing intensity of the conflict and reflects the creativity of actors in finding ways to mobilize more adherents to their cause by framing more extreme arguments on both sides of the fence.

Frame polarization refers to the increasingly extreme and evocative content of frames of both the proponents and the opponents involved in framing contests. The polarization of the framing activities in our case is a generalized phenomenon which involves all the core framing tasks, i.e. diagnostic, prognostic, and motivational (Benford & Snow, 2000). The concept of frame polarization describes how frames and framing contests unfold over time. It is thus different from previous concepts developed in the social movement literature, such as frame amplification (Snow et al., 1986) which refers to a strategy used by social movements to amplify values and ideologies present in a targeted field in order to mobilize new activists. To some extent, frame polarization is congruent with the observation of Tarrow (1989, 1998) who remarked that social movements are characterized by cycles of protest which tend to increase in intensity across the social system. However, instead of documenting the spread of the movement over a given population, our focus was on the intensity of their framing activity in framing contests.

Cumulative mechanism

Our work also extends the literature by documenting a cumulative process of phases of social movement activities where framing contests plays a critical role. We argue that the initial phase which we call necessary opening is the first layer upon which the organizing and mobilizing phase sediments and on which the environmental coalition is formed, and which in

turn constitutes the ground on which the powerful motivational frame “devaluation of the cars” could mobilize alternative channels. While the idea of sequence or phases (Schneiberg & Lounsbury, 2008) is not new in the social movement and the institutional theory literature, our contribution lies in our focus specifically on the evolution of framing contests by looking at both sides of the interaction.

The current literature suggests that the rise of new institutions never occurs from a clean slate. Rather, new institutions normally build upon fragmentary cultural materials which are at the disposal of social movement. Tarrow (1989, 1998) mentions that social movements engage in cycles of protest where the mobilization of certain tactics seem to follow a certain sequence. For example, a social movement transforms its tactics from protest to lobbying as the movement matures. Hoffman (1999) also suggests that the institutionalization of environmentalism follows specific sequences starting with its institutionalization through regulations which were then transformed into social norms and became afterward taken for granted in the chemical industry. Examining the evolution of frame alignment strategy of reforms in the public universities of the USA, Marichal (2009)found that frames evolve through different phases: accommodation (activists demonstrating the need to adopt reform), consolidation (building a core constituency of supporters) and bridging (converting those who are “on the fence” into activists). While these phases are close to ours, we extend his work in at least two respects. First, we focus on framing contests and on the framing activities deployed by proponents and opponents of new institutions. Secondly, we focus more on the framing tasks (Benford & Snow, 2000) than on the frame alignment strategy (Snow et al., 1986) deployed by the proponents of change.

Without explicitly documenting the cumulative effect of social movement activities with a special focus on framing contests, other studies show that a sedimentation mechanism is at play in the phenomenon they attempt to describe. For example, Minkoff (1997) shows how

the establishment of radical organizations created political opportunities for other groups to become activists. Also, the work of Lounsbury et al. (2003) suggests that effort deployed by not-for-profit organizations to institutionalize community-based recycling centres led to the establishment of the foundations of the for-profit recycling industry. In these examples it is clear that sedimentation played a role in the emergence of institution as activists and industrials build on existing previous infrastructure to develop their activities. While these studies are fundamental to the understanding of the evolution of institutions, they do not put a specific emphasis on framing contests.

Another related concept in the literature is the concept of accretion developed by Nigam and Ocasio (2010). Accretion accounts for the fact that fragments of frames (or theorization) bundle together to form an institutional logic. However, our cumulative mechanism differs from accretion as we are more concerned with how sequence of framing activities and action unfold over time than on how master frames (or institutional logics) are created out of fragments.

Effective motivational framing task: Negative individualized evidence-based consequences

Our results suggest that motivational frames play a central role in the resolution of framing contests leading to the emergence of institution. Motivational frames which resonated sufficiently to make customers exercise their purchasing power showed negative individualized evidence-based consequences of buying a Diesel car without the DPF. Because this motivational frame was supported by evidence, had negative consequences (i.e. losing money) which targeted specific individuals (customers of Diesel cars) and which was not counter-framed, we argue that these frames have a higher propensity to resonate. However, this motivational frame did not only resonate because of its properties. It is because the negative consequences were relevant to the target of the frame and because it sedimented on

the two previous phases, namely necessary opening phase and the organizing-mobilizing phase.

In our view, an important part of the current literature does not pay sufficient attention to the motivational framing task. Indeed, some important works do not consider this dimension in their analysis (e.g., Greenwood et al., 2002; Kaplan, 2008). Those who do mainly focus on what motivated people a posteriori (Garud et al., 2002; Maguire et al., 2004; Weber et al., 2008) rather than investigating the properties of the collective action frames deployed by the social movement and which would accomplish a motivational task. In other words, the currrent studies do not look at the arguments crafted by the movement. For example, the study of Weber et al. (2008) documented the reasons why farmers adopted the grass-fed meat and dairy product for their business instead of investigating the collective action frames deployed by the social movement.

However, the work of Benford and Snow (Benford & Snow, 2000; Snow & Benford, 1988; Snow et al., 1986) gave interesting insights on what make collective action frames effective. They must map onto the values of the targeted groups. Benford and Snow call frame alignment strategies the tactics used by social movements to mobilize individuals by aligning their frames to individuals' values and ideologies. However, frame alignment strategies neglect the study of the characteristics of frames to make them more influential than others, based on an analysis of their potential consequences. Our work shows that looking at potential consequences that motivational frames describe is essential to a better understanding of their potential to resonate. In addition to a good framing strategy, the social movement has to be perceived as credible (Benford & Snow, 2000) and it has to have access to various types of resources (McCarthy & Zald, 1977).

Institutional creation and the resolution of framing contests

Since it examines arguments deployed by proponents and opponents of the DPF, our work extends the literature by documenting how framing contests lead to institution emergence and how framing contests may be resolved. Thus we respond to the calls of scholars for more work on the role of social movement in institution creation (Hardy & Maguire, 2008; Schneiberg & Lounsbury, 2008).

The literature is replete with examples of institutions (Jepperson, 1991). The social movement literature has been particularly interested so far in explaining market creation (see for example the review of King & Pearce, 2010) and the emergence of organizational forms (Schneiberg & Lounsbury, 2008). The literature on institutional entrepreneurship (Hardy & Maguire, 2008) and on institutional pluralism (Kraatz & Block, 2008) has been interested in explaining the rise of institutional logics and how they compete with existing ones (Lounsbury, 2007; Thornton & Ocasio, 2008). Finally, with the exception of the work of Garud et al. (2002), the emergence of technological standard has attracted far less attention from both the institutionalists and the social movement literature. In this study, we looked at the emergence of a *de facto* standard (which emerges bottom up without being imposed), a type of standard which, we believe, has not attract much attention so far and its emergence through framing contests even less.

The literature which explores the link between framing contests and the emergence of institution can be split into that which studies how framing contests become institutionalized, i.e. different competing institutions emerge and endure in time, and that which focuses on how framing contests may be resolved by the victory of one clan or the dominance of one logic (or master frame) over the others.

Studies on institutional pluralism clearly attempt to understand how competing logics or framing contests emerge and become institutionalized. These studies show that institutional

fields are pluralistic and that when there is no possibility of framing contests being resolved, the conflict can be institutionalized, taking the form of competing institutional logics (Dunn & Jones, 2010; Purdy & Grey, 2009; Scott, Ruef, Mendel, & Caronna, 2000). For example, Purdy and Gray (2009) document strategies such as grafting and bridging being used by entrepreneurs to develop alternative practices which are institutionalized besides existing ones leading to the co-existence of conflicting logics in emerging fields (Purdy & Grey, 2009). Dunn and Jones (2010) documented how two institutional logics may be contested. They found that plural logics may coexist and the domination of a logic may oscillate over time, provided that both logics are necessary for the field: "If distinct logics are needed [such as in the medical school training: care versus science] but are advocated by different groups, then they may oscillate over time, as a group's power increases and decreases" (Dunn & Jones: 140). In this case, a balance between the two logics is necessary to avoid being vulnerable to rival groups such as managed care professionals. Another example comes from Weber et al. (2008) who show how the social movement contested the current meat and dairy product system by proposing as an alternative grass-fed meat and dairy products. The framing contest becomes institutionalized instead of being resolved as the creation of grass-fed beef products generates more competition with customers having more freedom to choose their dairy and meat products. In these papers, framing contests are institutionalized, leading to enduring competing institutional logics.

However, our results are closer to studies which document how framing contests support the emergence of one dominant institution to the detriment of others. This pattern has been particularly studied in the institutional logic literature where scholars have documented how one logic can shift another (Lounsbury, 2002; Thornton & Ocasio, 1999). The study of Nigam and W. Ocasio (2010) is particularly interesting as it shows how events can seal the fate of alternative institutions. They show that the elimination of political reform models as potential alternatives put an end to the framing contests surrounding the reformation of the health care

system in the USA and allowed for the establishment of the managed care logic as a dominant paradigm in health care. This phenomenon was possible due to the "growing theorization of multiple dimensions of a logic of managed care" (p.837) and to the fact that the "new logic is congruent with representative features and exemplars in the organizational field" (p.837). Our work extends this literature by showing that in addition to growing theorization (or framing) of multiple dimensions of a logic, there is also a cumulative mechanism at play which seems necessary for frames to perform a motivational task leading to the emergence of an institution.

Another stream of the literature on cognitive frames (Garud & Rappa, 1994; Kaplan, 2008; Kaplan & Tripsas, 2008) is more interested in understanding how convergence and dominance of frame emerges. For example, Kaplan (2008) argues that in order to resolve framing contests, actors and their frames must be credible and aligned with the interests of those they need to mobilize and must at the same time transform the interests of other actors. For this author, convergence around a predominant collective frame occurs through establishing legitimacy of the claims-makers and realignment of frame with the interests of those targeted by framing practices. Our work extends this literature by insisting on the role of motivational collective action frames and their characteristics.

Powerful actors may also intervene in order to resolve framing contests. When two entrepreneurs promote different incompatible forms through framing activity, tensions arise and an intervention from the state which may push for one organizational form to be adopted by several organizations may legitimate one organizational form and put an end to the existence of several organizational forms. It is now well documented that a coalition which obtains the most important political support is likely to see its frame becoming predominant (Brint & Karabel, 1991). Our study suggests that the kind it's unlikely that the social movement could have succeeded without the support of numerous powerful organizations in the coalition such WHO, Greenpeace, Friends of Earth, and child-care NGOs.

In this study, we examine how framing contests between proponents and opponents of the Diesel particulate filter (DPF) in Germany evolved over time to affect institution creation. Because our case study and our analysis investigate framing contests in detail, we believe that our results can be generalized to other settings having similar characteristics. More specifically, we believe that our results can be generalized to settings characterized by intense schisms between proponents and opponents to a cause where the establishment of a consensus over a norm or a standard is highly perilous. Settings where green technologies are promoted by activists such as the case of the catalytic converter in the automotive industry, the photovoltaic technology in the energy sector, the commercialization of nanotechnology, battles between environmentalists and the oil industry for having lead-free and sulphur-free fuel are likely to be characterized by these kinds of framing contests. However, it is clear that the themes of the collective action frames and the specific sequence of phases which we observed may be specific to our setting. As regard to the phases, we believe that they may appear simultaneously instead of sequentially in other settings.

We call for more work which would take into account the framing activities of both the proponents and the opponents involved in framing contests by paying particular attention to the properties of motivational framing task which lead to resonance, by theorizing the multiplicity of framing contests which characterize institutional wars, and by documenting other process patterns leading to the emergence of institution.

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Table 1.
Examples of the Coding Table

Frame task	Aggregate theme	Frame (Second order themes)	First order themes	Polarity	Fragments	Who?	Date	Source
Diagnostic	Public health issues	Diesel PM is likely to be harmful for human health	Diesel Particulate matter can cause cancer	Pro	Soot particles from diesel exhaust are becoming smaller and more dangerous. The theory stating that these particulates are harmful to health when inhaled, and in the worst case can cause cancer, has long been disputed among scientists. Now, this theory is proven.	Scientists	1997-10-11	Der Spiegel (weekly)
			Diesel is more likely to cause cancer	Pro	Today and in the foreseeable future exhaust from diesel engines are several times more prone to cause cancer than exhaust from gasoline engines.	Scientists	1999-01-21	Stern (weekly)
		No scientific evidence that Diesel PM is noxious for human	Negative effect of the diesel exhaust on human health cannot be proven	Con	Recent research by the U.S. Health Effects Institute show that exhaust from modern diesel engines cannot be related to negative health effects on humans	German car industry (President of Association of the Automotive Industry)	1999-08-22	Welt am Sonntag (weekly)
			Negative effect of the diesel exhaust on human health cannot be proven.	Con	Dr. Norbert Metz, BMW AG, [...] pointed out that it has not been scientifically proven that diesel particulate matters have an effect on health. He argues that transferring the results of tests performed on rats to humans is questionable.	German car industry (Norbert Metz from BMW)	2000-04-18	ADAC Flughafengespräche
Prognostic	Technological risks & benefits	DPF is a solution to reduce Diesel PM	Peugeot's DPF technology works	Pro	The only remaining problem with modern diesels is the particulates. We are proud to announce that we have developed the world's first efficient soot particulate filter that comes [...] with the Peugeot 607 HDI.	PSA Peugeot / ADAC (Jean-Martin Folz, CEO of PSA)	2000-01-13	Die Zeit (weekly)
			Peugeot's DPF technology works	Pro	It has been a while since the filter for diesel engines in the Peugeot 607 proved to be successful. The tests show that even after 80 000 kilometres, the filter was still working as good as a new one. For a little extra manufacturing cost, the filter should be able to eliminate 99.9% of fine particulates.	Federal Environment Agency (UBA) & ADAC	2001-09-30	Die Welt (daily)

Table 1 (continued).
Examples of our Coding Table

Frame task	Aggregate theme	Frame (Second order themes)	First order themes	Polarity	Fragments	Who	Date	Source
Prognostic	Techno-logical risks & benefits	DPF is not a good solution to reduce Diesel PM	Discredit DPF technology.	Con	By using diesel particulate filters, we resolve one problem to create another one [...] as it is increasing consumption and CO2 emissions.	German car industry (president of Mercedes)	2001-11-19	Der Spiegel (weekly)
			Discredit Peugeot's DPF technology	Con	This is just marketing campaign of the French.	German car industry	2003-02-26	Süddeutsche Zeitung (daily)
Motivational	Economic risks and benefits	Devaluation of the diesel cars without filter	Cars without DPF will lose in value	Pro	Customers who buy cars with an older technology will be disappointed as the loss of value for diesel cars without particulate filters will be high in the next few years.	Environ-mental Movement	2004-01-26	DPA (press agency)
			Cars without DPF will lose in value	Pro	New cars without particles filters will dramatically lose their reselling value	German Environmental Aid (Jürgen Resch)	2004-07-15	Die Welt (daily)
		The value of diesel cars will not change without filter	Counter-argument to "Cars without DFP will lose in value"	Con	The rumours pretending that cars without soot filters will lose 1000 € per vehicle do not match the facts.	German car industry	2005-05-17	Börsen-Zeitung (daily)

Table 2.
Frames and Counter-Frames Promoting the DPF: January 1985 – October 2002

Date	Aggregate Themes	Framing tasks	Proponents frames	Opponents counter-frames
January 1985 – October 1999	Public Health issues	Diagnostic	Diesel particulates cause important health problems, are probably carcinogenic, lead to inflammatory processes, etc.	Soot has no effect on health
				No evidence that soot increases cancer risks
			Enters the bloodstream and brain	
	Risks and benefits of the technology	Prognostic	Filters would be a response to lower soot particulate emissions	Technological infeasibility
				Lean-burn engine is a better alternative technology
				Filters are too expensive to produce
November 1999	Risks and benefits of the technology	Prognostic	Diesel cars of German manufacturers are polluting	
			Peugeot's cars are clean because they are equipped with the DPF	Due to additive, Peugeot's technology is even more polluting
			Filters are a proven solution to lower Diesel PM emissions	Peugeot uses the DPF to compensate its ineffective Euro 3 Diesel engines
				French technology is ineffective
				Internal engine methods are a better alternative technology
March 2000	Public health issues	Diagnostic	Diesel particulates cause important health problems (probably carcinogenic, lead to inflammatory processes)	Lack of scientific evidence supporting detrimental health effects
			Enters the bloodstream and brain	
October 2000 – August 2001	Risks and benefits of the technology	Prognostic / Diagnostic	ADAC experiment preliminary and final results show that DPFs are effective in limiting Diesel soot particulate emissions	
October – November 2001	Economic risks and benefits	Motivational	DPFs do not increase fuel consumption	DPFs increase fuel consumption
March 2002	Public Health issues	Diagnostic	Diesel particulates cause important health problems (cancer, throat, lung and cardiac problems)	Soot has no effect on health
			Diesel soot particulates penetrate the body (the circulation system, the brain)	
September 2002	Risks and benefits of the technology	Prognostic	DPF is an effective technology	Internal engine methods are a better alternative technology
			DPF is the best available technology	
			Car manufacturers could instantly equip all their cars with DPFs	
			If the French car manufacturers can do it, so should the Germans.	
September/ October 2002	Regulatory Intervention	Motivational	Tax incentives should be introduced	
			Current emission standards are inappropriate	

Table 3.
Frames and Counter-Frames Promoting the DPF: November 2002 – February 2004

Date	Aggregate Themes	Framing tasks	Proponents frames	Opponents counter-frames
November 2002	Cohesion/ fragmentation	Motivational	Bringing members of different organizational field together	
December 2002	Risks and benefits of the technology	Prognostic	Filter is effective, even children can show it (the experiment)	
	Behaviour (in)appropria-teness	Motivational	Not taking into account evidence that the DPF is effective is irresponsible	The experiment was inappropriate because it involved children
	Public health issues	Diagnostic	Increases the number of deaths Poses high risks for children	
	Economic risks and benefits	Motivational	Filter decreases fuel consumption	Filter increases fuel consumption
February 2003	Economic risks and benefits	Prognostic		Consumers have no willingness to pay for environment-friendly products
	Cohesion/ fragmentation	Motivational	Movement is ready to support car manufacturers which would use filters	Ford Germany asked for red card like the other car manufacturers to preserve solidarity
	Behaviour (in)appropria-teness	Motivational	Symbolically penalizing those who do not use filters	German industry reacts by sanctioning players who are ready to collaborate with the movement
March 2003	Risks and benefits of the technology	Prognostic	The DPF is an effective technology	Alternative technology is better
July 2003	Regulatory intervention issues	Motivational	Taxes on Diesel cars or taxes on Diesel fuel should be increased Law should enforce DPF	Taxes on Diesel cars or taxes on Diesel fuel will not be increased
	Public health issues	Diagnostic	Study published by the government shows that 14000 people die ahead of their time in Germany due to Diesel fine particulates	
	Behaviour (in)appropria-teness	Motivational		Saying that 14000 Germans are dying every year due to Diesel soot is pure panic mongering
	Public health issues	Prognostic	DPFs would increase the life expectation in Germany by 1 to 3 month	
August 2003	Cohesion/ fragmentation	Motivational		Car manufacturer D has the filter, but does not want to be the first mover. Car suppliers support the movement German car manufacturers threatened filter suppliers to terminate their contracts if they collaborate
	Public health issues	Diagnostic	Diesel PM causes important health problems	
September 2003	Economic risks and benefits	Motivational		We [industry] will do what the market asks
February 2004	Public health issues	Diagnostic	8500 people die ahead of their time in Germany	

Table 4.
Frames and Counter-Frames Promoting the DPF: March 2004 – June 2005

Date	Aggregate Themes	Framing tasks	Proponents frames	Opponents counter-frames
March 2004	Public health issues	Diagnostic	Science has proven that soot particulates cause health problems	
	Risks and benefits of the technology	Prognostic	DPF technology is effective	
April 2004	Public health issues	Diagnostic	Diesel PM causes important health problems	
June 2004	Regulatory intervention issues	Motivational	Tax incentives favouring the introduction of the DPF might resolve the problem of soot particulate	Tax incentives might kill the Diesel car industry in Germany Tax incentives might kill alternative technology
July 2004	Economic risks and benefits	Motivational	Cars without filter will drop dramatically in value	
March 2005	Public health issues	Diagnostic	Diesel particulates cause important health problems such lung cancer and heart problems 65'000 people die ahead of their time due to air pollution caused by fine particulate matter	Diesel particulates are only a small part of the fine particulate matter pollution problem
	Regulatory intervention issues	Motivational	Ban cars without filter in inner cities	
	Cohesion/ fragmentation	Motivational	To protect the German automotive OEM, the German government delayed the introduction of tight thresholds	
	Risks and benefits of the technology	Prognostic	Filters are effective	
	Regulatory intervention issues	Motivational		The tax debate has negative effects on the buying behaviour of the consumers Regulation would have negative effects on German car industry
May 2005	Economic risks and benefits	Motivational	Cars without filters will lose dramatically in value	A loss of 1000 EUR in resale price is exaggerated
	Public health issues	Diagnostic		Diesel particulates are only a small part of the fine particulate matter pollution problem
	Regulatory intervention issues	Motivational	The filter technology will only penetrate the market if there are tax incentives	Regulation would have negative effects on German car industry
June 2005	Behaviour (in)appropria-teness			Mr Y is a trouble-maker for the car industry

Table 5.
Framing Polarization

Aggregate Themes	Actors position	1985 – 1999	1999	2000	2001	2002	2003	2004	2005
Public health issues (Diagnostic framing tasks)	**Proponents**	Involved in cancer	Involved in cancer	Involved in cancer	Involved in cancer	Number of deaths increases High risk for children	14'000 deaths		
	Opponents	Lack of evidence	Lack of evidence	Lack of evidence	Lack of evidence Evidence is biased due to studies on rat	Lack of evidence Evidence is biased due to studies on rat	Inappropriate behaviour (panic mongering)		
Risks and benefits of the technology (Prognostic framing tasks)	**Proponents**	Filter as a potential solution	With Peugeot, filter is a commercialized solution	Some evidence from the Automobile Club (ADAC)	Solid evidence from the Automobile Club (ADAC)				
	Opponents	Filter is an ineffective technology	Peugeot's filter pollutes more						
Economic risks and benefits (Motivational framing tasks)	**Proponents**				Filter does not increase fuel consumption (no cost having a filter)	Filter does not increase fuel consumption	Filter does not increase fuel consumption	Without filter, the value of a car drops (Not having a filter has an important cost)	Without filter, the value of a car drops
	Opponents				Filter increases fuel consumption (Having a filter has a cost)	Filter increases fuel consumption	Filter increases fuel consumption	Filter does not affect the value of cars (Not having a filter doesn't affect the reselling price)	Filter does not affect the value of cars
Regulation intervention issues (Motivational framing tasks)	**Proponents**					Tax incentives favouring introduction of filter	Tax incentives favouring introduction of filter	Tax incentives favouring introduction of filter	
	Opponents						There is no need for tax because filters are not necessary	Tax will kill the auto industry Tax may kill the lean-burn engine technology	

Frame Polarization →

Table 6.
The Cumulation of Phases

Date	***January 1985***		***November 2002***		***June 2004***	
Phases	**Necessary Opening**		**Organizing-Mobilizing**		**Instrumentalization of Channels**	
Aggregate Themes	Public health issues	Technology risks and benefits	Cohesion / fragmentation	Behaviour appropriateness	Economic risks and benefits	Regulative issues
Cumulative effect